





## THE RELATIONS OF CHRONIC VILLOUS POLYARTHRITIS TO THE DUMB-BELL SHAPED BACILLI.

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ROADES FAYERWEATHER, in an interesting article entitled "Infectious Arthritis, a Bacteriological Contribution to the Differentiation of the Rheumatic Affections," which appeared in THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, December, 1905, referred to my distinction of articular inflammations according to, or corresponding with, bacteriological, anatomico-pathological, and clinical observations and studies, which distinction I had planned first in the year 1897 and completed later on.

Dr. Fayerweather partly confirmed me in my descriptions, but to some extent he does not interpret my views correctly. The erroneous statements of Dr. Fayerweather I cannot leave undisputed, since I am the one who has advanced the new point of view in classifying diseases of joints.

First of all I cannot agree with Dr. Fayerweather when he applies the too insignificant term "infectious arthritis" instead of my own designation "polyarthritis chronica villosa (bacillaris)," for which latter name I have given scientific reasons. Some of Fayerweather's errors are due to the fact that he has drawn conclusions from his own observations made on comparatively scanty material, and has not taken into consideration the result of my investigations, for which I had a hundred times as much material at my disposal to make cultures. It is apparent that Fayerweather does not know all my publications on this subject, nor my writings on diseases of the joints in general. Concluding his article, Dr. Fayerweather invites further researches on the bacteriology of the articular affections under consideration, and in this I concur with him. I wish, however, to call attention to the scientific standpoint on the broader basis given in my own work on *Diseases of the Joints*, the significance of which for the topic will be readily understood.

As long as twenty-eight years ago—I was at that time clinical assistant and collaborator of Professor Carl Hueter, and we had a very large number of cases of joint diseases at the surgical clinic at

Greifswald—I was led to make numerous clinical, pathological, anatomical, and bacteriological investigations of these diseases, and to experiment on animals in order to study the causes, the origin of the different forms of arthritic inflammations. The researches were published in different journals and formed also part of my book: *Experimentelle und histologische Untersuchungen über die Entstehung und Ursachen der skrophulösen und tuberkulösen Gelenkleiden, nebst Studien über die tuberkulöse Infektion und therapeutischen Versuchen*.

Since my removal to the University of Berlin I have studied several years, with Professor Rudolf Virchow's kind consent, in the Berlin Pathological Institute, a very large number of bodies, especially the joints, for different joint diseases, anatomically, histologically, as well as pathologically. My results were published at intervals in medical journals, in papers read in scientific sessions, among others before the Congress of German Surgeons in the year 1884. Again at that time I experimented on animals by inoculating cultures of different micro-organisms, especially such taken from metastatic inflammations of puerperal fever, but also from otherwise diseased joints. Not only by these studies, but more so by constantly increasing clinical observations—in the average during the year from 500 to 600 patients afflicted with joint disease were treated by me in private clinical and astyclinical<sup>1</sup> practice—I became convinced that the existing classifications of articular inflammations of Volkmann, Hueter, and the English and French authorities were untenable. Some of these old classifications were made on the basis of anatomical changes; some surgeons had been quite arbitrary in classifying, some illogical in considering accidental causes; altogether they were unsatisfactory in every direction from a scientific and practical point of view.

For this reason I made the attempt to group the inflammations of the joints more correctly and more practically, comprising always the etiological moments, the pathologico-anatomical changes, and the most important clinical symptoms. According to these leading points of view I considered in my book, *Die Pathologie und Therapie der Gelenkentzündungen*, published in the year 1887, under the following head groups:

1. Simple acute serous arthritis;
2. Simple chronic serous arthritis (hydrarthron);
3. Suppurative arthritis; suppuration of joints;
4. Arthritis in acute infectious diseases, "metastatic arthritis;"
5. The rheumatic arthritis: (a) acute articular rheumatism; (b) chronic rheumatic monoarticular inflammation; (c) chronic rheumatic polyarticular inflammation;
6. Senile arthritis;
7. Arthritis deformans;

<sup>1</sup> Not policlinical nor polyclinical, because both these names are wrong, according to Rose.

8. Gouty arthritis: (a) acute; (b) chronic;
9. Syphilitic arthritis: (a) in the secondary, (b) in the tertiary period, (c) in hereditary syphilis;
10. Tuberculous arthritis;
11. Neuropathic arthritis.

I defined and characterized every group as distinctly and precisely as possible, in order to enable us to arrive at a clinical diagnosis of every form of arthritis, and to establish therapeutic rules corresponding with etiological conditions, the most important anatomico-pathological changes, and the clinical symptoms.

My own observations and studies of a great many cases in private, clinical, and astyclinical practice, on the one hand, and the confusion existing and manifested in public discussions among the internal clinicians and spa physicians in regard to the conception and designation of diseases of the joints, on the other hand, induced me to establish a clearer discrimination of what is understood by rheumatic processes in the joints, sometimes attributed to rheumatism in the joints, sometimes called arthritis deformans, sometimes confounded with gout.

In the year 1892 I discovered a peculiar, very small, plump bacillus in the tissues of some joints filled with villous excrescences; because of its peculiar shape I gave it the name dumb-bell bacillus. Characteristic were in such cases the clinical symptoms, the anatomico-pathological peculiarities, the presence of multiple or many villous excrescences on the whole inner surface of the synovialis, the typical structure of proliferating endothelial cell groups *surrounding numerous small vessels*, and differing from those in tuberculous tissue, and the presence of many dumb-bell shaped bacilli between and in the cells of the newly grown hyperplastic tissues of the synovialis and the villous excrescences. The additional fact that I had succeeded by experimenting in causing the same villous process on the synovialis in joints of animals by means of injections of pure cultures of the dumb-bell bacilli, while many other experiments made by me with other bacteria had never resulted in villous excrescences; in short, all these clinical and bacteriological reasons determined me to distinguish between this form and other forms of arthritis and to describe it as chronic villous bacillary inflammation.

We have, it is true, villous excrescences in other forms: for instance, in arthritis deformans, sometimes in syphilitic and sometimes in neuropathic arthritis, etc.; but I could demonstrate, for example, by means of careful histiochemical and physiological investigations, that in arthritis deformans all those changes which can be easily demonstrated in the living by means of Roentgen rays, and which have been characterized by Virchow, Barwell, and Volkmann as the result of puffing, blowing up, disrupting, grinding, polishing, leading to deformation of the cartilaginous parts of the joints, do not depend on the presence of bacilli but on pathological changes in the process

of resorption and secretion of lime. It is the anomalous secretion of lime, principally in the cartilaginous, later also in the synovial tissues of the joints, which leads to necrotic changes in microscopic spots and to a simple inflammatory reaction and small cell proliferation beneath these spots, but not those foci around small vessels, as in the chronic bacillary villous process.

I was enabled to demonstrate this by histiochemical conversion of the surplus of lime into the characteristic crystals of lime oxalate in the cartilage as in the less numerous solid and hard synovial excrescences of arthritis deformans. As a matter of fact they are not necessarily present and not a characteristic feature in arthritis deformans. I had taken many photomicrographs of slices of arthritis deformans as well as of slices of characteristic villous excrescences and of synovials from chronic bacillary villous synovitis, and presented them before the Hufeland Medical Society on July 6, 1899. The paper read on that occasion, with illustrations, appeared in the *Berliner k'in. Wochenschrift*, 1900, Nos. 5, 6, and 7, and was entitled "Polyarthritis Chronica Villosa and Arthritis Deformans." I could convince myself later on that neither the hard villi in arthritis deformans nor those in pure syphilitic cases, nor the rarer ones in other forms of arthritis had dumb-bell shaped bacilli, with one exception, namely, in some cases of chronic villous polyarthritis in joints which at a former period had undergone syphilitic changes. Here I found the characteristic villous excrescences with dumb-bell bacilli, beneath them occasionally deep lacunous defects or flat cicatrizations in the cartilaginous or osseous parts of the joint, and these conditions were seen not only directly at operation on such joints, but even by means of Roentgen rays. In these cases there were also present syphilitic parasites, although, judging from their hyaline condition, syphilis was no longer active in these joints. Antisyphilitic treatment in such cases had no effect. It is possible that preceding syphilis, tertiary as well as hereditary, had given a predisposition to invasion of dumb-bell bacilli into the joints.

I do not know of any special relation of chronic villous polyarthritis to articular rheumatism. Among the great number (230) of my own observations I found only very rarely cases with a history of acute articular rheumatism. In the great majority of the cases the affection began *per se* instantaneously, with villous excrescences which progressed slowly. The process took place first in one or in a few joints, as a rule at first in the smaller ones, then gradually in others; sometimes, however, larger joints—the knee for instance—were the first. In my large experience with this form of arthritis I could establish with certainty that it never began with fever and swelling. I do not believe that the well-studied disease, which we are accustomed to call acute articular rheumatism, is ever caused by invasion of dumb-bell bacilli. In my earlier experiments I succeeded occasionally in producing acute serous or seropurulent inflammation



of several or nearly all joints in animals, which inflammation resembled acute rheumatism, by injecting cultures of bacteria, especially streptococci, pyogenic, septic (puerperal fever), and others, never, however, by injecting cultures of dumb-bell bacilli. In later publications<sup>1</sup> I distinguished positively between rheumatic arthritis (acute articular rheumatism, chronic rheumatic arthritis), polyarthritis chronica villosa (bacillaris), and arthritis deformans.

Chronic villous polyarthritis bacillaris in men begins usually with the development of villous excrescences. I have often convinced myself of this fact. The growing villous excrescences originate always from distinctly known parts of the synovialis, first described by me as peculiar to every joint, but they grow generally in one direction more massive, and pull, therefore, as a rule the capsule of the joint more in one direction than in other directions. This asymmetric extension of the capsule by the growing villous excrescences is quite a characteristic feature of the chronic villous bacillary polyarthritis. In most cases the villi can easily be felt. The cartilaginous parts of the joints remain unchanged, as can easily be seen in operation and by means of the Roentgen rays. There is the one exception, however, namely, in cases of preceding syphilitic gummatous destruction of the cartilaginous and osseous parts, of which I have spoken above. These destructions can also be differentiated by means of Roentgen rays from the deformations of arthritis deformans. The outside appearance of joints affected by chronic villous bacillary polyarthritic inflammation present, it is true, likewise more or less deformity in many instances, but the type of this deformity is as a rule of quite a different kind from that of the deformity in arthritis deformans. Moreover, there are the different clinical symptoms which characterize the one form and the other, and thus there is no difficulty in distinguishing chronic villous bacillary polyarthritis. Characteristic, for instance, is the lateral roof-tile deviation of the fingers when the metacarpophalangeal joints are affected. This peculiarity is caused by the one-sided protruding growth of the villous excrescences and the very early marked atrophy and palsy of some muscles and nerves.

In the shoulder-joint larger excrescences are rarely noticed. Here I found more often the cicatrizing form, which I call ankylopoietica, while the other form is named hyperplastica. Both forms are, as I could establish by histological and bacteriological examinations, of the same origin and are not seldom found together in different joints of the same patient.

In the elbow-joint the process begins, as I observed, very often in the synovialis under the ligamentum annulare around the head of the radius, and can be diagnosticated here very distinctly by careful palpation. The anterior and posterior cavities of the humerus are

<sup>1</sup> Zur Behandlung einiger chronischer Gelenkleiden. Mediz. Wochens. 1903, No. 30. Arthritis, Encyclopädie der praktischen Medizin, Wien, 1905.

likewise the seat of this development, and here they interfere at an early period with articular movements.

In the hand the little joint between the ulna and the radius, as well as the wrist-joint, are affected by the disease, and here it can be easily and early diagnosed.

The hip-joint is attacked mostly in very severe cases; here it causes fixation in the state of extension.

The knee-joint is very often affected and can be filled with the larger masses of villous excrescences. I am certain many cases described in literature as lipoma arborescens were in reality villous polyarthritis. The asymmetrical clumsy swelling of the joint and the perception of the villi by digital examination facilitate the diagnosis in old cases. But even in recent cases, especially in those near the lateral ligaments and in the circumference of the patella and the ligamentum patellæ, we may notice the first formations of villous excrescences. Those behind the lateral ligaments will early give rise to trouble, pain on digital pressure, and in females sometimes swelling during the time of the menses.

The changes in our affection present quite another picture from, for instance, those of tuberculous or syphilitic arthritis. Troubles in walking appear at an early period as a rule, but swelling in tuberculosis is usually more diffuse, besides being nearly always connected with a tuberculous focus in some osseous part of the joint, as can be detected by careful Roentgen-ray examination. Roentgen rays may also serve to distinguish between chronic villous polyarthritis and arthritis deformans in cases in which there exists any doubt. Very often, however, the experienced surgeon, simply by means of inspection, palpation, motion, examination for friction sound, etc., will have no difficulty in regard to differential diagnosis.

In the ankle-joint the villous excrescences are mostly found at the outer part of the articulation near the malleolus externus and also near the margin of the cartilaginous surfaces.

In order to arrive at a diagnosis in a case of chronic villous polyarthritis bacillaris we need not necessarily resort to a bacteriological examination, since the symptoms which I have described in my publications, and which I have briefly enumerated here, are very characteristic. I demonstrated, however, in 150 out of my 230 cases the presence of dumb-bell bacilli.

I made cultures from aseptic punctures of unopened joints with a special puncture needle and also from all my operated cases (30). In some cases I excised villous excrescences and parts of the synovialis, placed them between aseptically cemented sterilized glass shells and then in the abdomen of living rabbits, examined them ten to fourteen days later; or placed them in sterilized tubes closed by rubber stoppers in the thermostat, kept them there for a few days at a temperature of 37° to 37.5° C., and then made cultures from these particles on different culture media; or I made cultures after

centrifugation of fluid taken under aseptic precautions from a diseased joint. Besides, I made in all cases operated on, and in hundreds of cases treated by injection, dry cover-glass preparations. I am in possession of a large collection of microscopic sections of tissues taken from my operated cases, of cover-glass preparations, and of cultures made after I had experimented with the bacilli on animals, and had many photomicrographs made.

Dr. Fayerweather believes, as stated in his article, that the bacilli which he found in his few cases were not the same as those described by me; but it has to be emphasized that he refers only to my first publication of cultures and experiments on animals from the year 1893, and not to all my later writings. At that time (1893) I was in about the same position as he is now. I had made only a few cultures of bacilli taken from joints affected with our disease and few experiments on animals. I did not, however, give my first observations as conclusive ones, but reserved my opinion until further investigation. As stated already, my observations extend now over 230 cases, which I have studied and described as mentioned above.

In regard to the cultures of dumb-bell bacilli, I wish to reiterate from my last publication that I always stain with Gram. In exceptional cases I found that cultures under Gram treatment would turn a little paler, but they never became discolored. There may arise some misinterpretation in regard to this point by those who have read only my first communication of 1893, in which I speak of easy staining and decoloring, but this refers essentially to some coloring of the cuts and cover preparations with following simple alcohol washing, not to the staining with Gram, which gives, as stated, no difficulty.

The dumb-bell bacilli, according to latest measurements which I took last summer<sup>1</sup>—and I had a large collection of my own cultures of microscopic preparations, to serve for my purpose—showed the following proportions: length 1 to 2 to 4  $\mu$ , width 0.25 to 0.75  $\mu$ .

After repeated inspection of many microscopic preparations of slices, cultures, dry cover-glass specimens, taken from patients as well as preparations taken from joints, blood-cultures from animals, I am certain that the name I have given to the bacillus causing polyarthritis chronica villosa in the joints, although not conspicuously adaptable in every specimen, characterizes without question, in the greater majority, very well the form of the bacilli, and, therefore, I wish to suggest to retain this name "dumb-bell shaped bacilli" exclusively for the bacilli of polyarthritis chronica villosa.

In some exceptional cases they are very short and clumsy with only a light compression in the middle, so that they resemble some-

<sup>1</sup> Berlin. klin. Wochenschr., 1905, No. 40.



what gonococci, but they become stained with Gram, while the gonococci will be decolorized by Gram; besides the thick, short forms develop the longer dumb-bell shape as soon as they grow on a suitable culture soil. The same applies to the other varieties of the form which seem to be influenced by the different conditions of nutrition, as well in tissues of men and animals as in the culture soil.

In other exceptional cases they resemble diplococci, but as a rule the dumb-bell shape is very striking, with roundish poles and a middle part. The middle part may be short or unusually broad; there are found also sometimes specimens in which the lateral parts are more rod-like, etc. Sometimes they lay singly, sometimes they are arranged regularly, two by two, like diplobacilli, etc. Since I found the different forms and relations not only in the tissues of the same case, but very often in different cultures and in different soils, and found that the different forms originate from bacilli of one and the same first or typical form, and as this fact became confirmed very often in my cases, as for instance again in a case of disease of the knee joint in a man of fifty years, operated on a few months ago, I cannot think that these modifications of form correspond with different kinds of bacilli, but I am convinced that they all are the same original bacilli which I have named dumb-bell bacilli of polyarthritis chronica villosa.

Comparing the culture table of Dr. Fayerweather given in his article with many cultures, I think that his Bacillus 1 and Bacillus 3 are identical with my dumb-bell bacillus; form, measure, staining by Gram are the same; in addition many of the culture properties are almost the same as far as I can judge. His Bacilli 3 and 4, decolorized by Gram, must be excluded, and the cases from which they were taken are not cases of polyarthritis chronica villosa.

In excluding those cases we exclude the supposed etiological connection of polyarthritis chronica villosa with acute articular rheumatism, to which latter class belongs Fayerweather's fourth case; it has nothing to do with the disease which I call polyarthritis chronica villosa.

It is true, however, as pointed out before, that joints which at sometime previously have been the seat of rheumatism may likewise become the seat of a chronic villous bacillary process, exactly as it may well happen that at some remote period a gonorrhœic or other form of arthritis existed in these joints; but such occurrences are rare, and when they happen, we may find in the joint beneath the dumb-bell bacilli small accumulations of gonococci or other pyogenic bacteria. I have had some such cases under observation. Some months ago I operated on the knee joint of a patient, and in this case I at first believed that there existed a complication: dumb-bell bacilli and gonococci together, when I recollected that nine years ago I had operated on the other knee joint of this patient—with best success as to mobility and at that time had found numerous rather long

dumb-bell shaped bacilli. Staining with Gram and cultures, which I made after the last operation, proved the error: there were no gonococci, but only dumb-bell bacilli.

Summing up, I wish to say that I am convinced the disease which I described as polyarthritis chronica villosa is caused only by the bacillus which I have called dumb-bell shaped, and not by any other kind or form, and that this disease has no near etiological relations with acute rheumatic arthritis. It is to be hoped that my statements given in this paper will induce others to make further investigation. I shall be especially gratified if American colleagues will follow Dr. Fayerweather, to whom I am thankful for his interest in my labors, in studying the matter on a larger scale.





